Reviews and Abstracts: Vol. 1, No. 4

ADMINISTRATION AND OPERATION OF COMPUTER CENTERS

125:

DONEGAN, J. J. **Computer tapes demand protection.** *Systems* **25**, 1 (January–February 1960), 11–12.

This article describes the destruction to the unprotected Mylar tapes during the recent fire in the Air Force Computer Center at the Pentagon. The author lists five lessons that this fire can teach management. The first four lessons are quite realistic. These lessons are: the *contents* of a "fireproof" building are not fireproof; Mylar tapes are highly flammable, and replacement of destroyed tapes is expensive; storage of tapes in vaults is impractical; and, punched cards stored in "Safe-File" units were not destroyed by the fire. The fifth lesson, which is that Mylar tape stored in "Safe-File" units are protected from fire damage, is not quite as realistic because the author does not give any scientific basis for his conclusion.

T. E. Cheatham, Jr., Alexandria, Va.

126:

● BOAZ, MARTHA (Editor) **Modern trends in documentation.** Pergamon Press, Inc., New York, 1959, 8 + 103 pages, $5.00.

This slim 100-page volume represents the proceedings of a symposium held at the University of Southern California in April 1958. The symposium "was held for the purpose of stimulating interest in information retrieval."

Included in the proceedings are some general papers by Robert S. Meyer, H. J. R. Grosch and Merrill L. Kastens. There are two papers on problems relating to machine translation by H. P. Edmundson and D. G. Hays. Various aspects of information retrieval are treated by H. P. Luhn, Don D. Andrews, Harley Tillitt and Peter K. Worsley. An additional paper on the specialized activities of a particular commercial company was presented by Robert Hayes. The volume concludes with comments presented by a group of panelists.

This book points up the difficulties in publishing proceedings with such a considerable time lag between the symposium and the appearance of its proceedings. The information contained in most if not all of the papers has appeared extensively in the literature and at this point represents little that is new except its compilation into a single volume. This is, of course, worthwhile but it would be much more so if there were better representation of all the manifold activities that are going on concurrently about the country; this volume contains reports on only a small portion of this effort.

An additional particular point must be made. Nowhere in this reviewer's experience has he encountered a technical or semi-technical publication with so inadequate and badly constructed an index as appears in this particular book. As an example, the term *automatic digital computer* appeared with just one page reference in the index, although this particular item was a recurrent theme throughout most of the volume. On the other hand, there is a reference in the index to *epistemology*. The indexed material is found in two sentences: "I believe that our foundation in basic science is inadequate, but I think that the deficiency is in such sciences as linguistics and semantics and, quite probably, in classical logic and epistemology. ... I am not sure, however, we know how to set up a research team to tackle a problem in epistemology, or in semantics."

Another illustration is the following sentence: "The data handling people are very much concerned with the invention of gadgets, such as character sensors and page readers, which will electronically scan a page of print in any type face and record the information there on more machineable media such as magnetic tape ...", which appears on page 15. This sentence can be found indexed under the terms *gadgets* (!), *character sensors*, and under *page readers*. On the other hand, an extensive description of vacuum transport drums, which covers the better part of page 78, is not indexed at all.

Jack Moshman, Arlington, Va.

APPLICATIONS TO LINEAR AND DYNAMIC PROGRAMMING

127:

ROYTENBERG, YA. N. **Some Problems in Dynamic Programming.** *Prikladnaya Matematika i Mekhanika* **23**, 4, (1959), 656–665. (Russian)

Conditions are deduced for the supplementary forces appearing in the equations of motion of a nonstationary linear system which guarantee that a preassigned motion be a solution of this system. This is done for both continuously acting and impulsive systems, the first being characterized by Eq. (1.1)

$$\sum_{k=1}^{n} f_{jk}(D)y_k = x_j(t) + q_j(t) \quad (j = 1, \cdots, n) \quad (1.1)$$

and the second by a similar system of difference equations in which the differentiation operator $D = d/dt$ is replaced

by the (prediction) operator T satisfying Eq. (2.2):

$$T^s y_k = y_k(t + s\tau) \qquad (2.2)$$

An approximation method is described for solving for the required supplementary external forces which the author notes can be carried out by means of electronic computors. Here, y_k are generalized coordinates, $x_j(t)$ are given external forces, $q_j(t)$ are the additional external forces, and τ is a certain constant. $f_{jk}(D)$ denotes a polynomial in D with given coefficients depending only on the time t. The author first solves each equation of the system for the sum of the highest order derivatives of each of the y_k and then, under the assumption that the coefficient matrix is nonsingular, solves for each of the highest order derivatives. New variables $z_i(t)$ are introduced for each of the y_k and their lower order derivatives. This leads to a linear system of the form shown in Eq. (1.10),

$$z_j + \sum_{k=1}^{r} a_{jk}(t)z_k = X_j(t) + Q_j(t), \qquad j = 1, \cdots, r, \quad (1.10)$$

whose solution is then written down in terms of a fundamental set of solutions of the homogeneous system. By some additional manipulations, this solution is converted to the sum of two terms, the first being a sum corresponding to the initial data and the second being a sum of integrals. Their kernels depend on the weight function of the transformed system. The remaining multiplicative factor is the sum of the given and additional forces. Assuming from some definite time onward the solution $z_i(t)$ to be given, the author obtains a set of integral equations for determining the unknowns q_j. Certain q_j are set identically zero (if there are more) in order to make the number of q_j and y_k agree. This system is solved in the following manner. The interval of integration is divided into a number of subintervals inside of which each q_j is assumed to be constant. This gives a recursive system of relations for successively finding their values. If the number of q_k, to start with, is less than the number of y_k, then the original integral equations can be satisfied only for discrete $t = T_p$, $p = 1, 2, \cdots$. That is, again assuming the q_j to be step functions, their values can be determined in an interval (t_0, T_1) from a linear system of algebraic equations. These values, however, can only guarantee that at $t = T_1$ the z_i will take on the preassigned value at $t = T_1$. This process can be repeated in a subsequent interval (T_1, T_2), etc. For the case of impulsive systems, analogous transformations are performed and a set of equations analogous to the integral equations is derived. An approximate set of recursive relations is then obtained by assuming that the q_j are step functions. The situation where the number of q_j is less than the number of y_k is handled in essentially the same way as before. In both cases the author notes that to find the kernels it is necessary to solve an auxiliary, homogeneous, system of differential or difference equations. There are 10 references —7 Soviet, 3 U.S. *(Translated from the Abstract)*

128:

MOLES, ABRAHAM A. **Principes d'incertitude de la perception et machines philosophiques** (Principles of uncertainty in perception and philosophical machines). *Cybernetica* **2**, 1(1959), 51–57. (French)

The author enunciates two principles of uncertainty in perception: I. The product of the uncertainty concerning the amplitude of a signal and the uncertainty concerning its frequency is a constant which is inversely proportional to the time of observation. II. The product of the uncertainty concerning the form of a message and the uncertainty concerning the duration of the message is constant. He sees these principles as the exact analogues in the world of perception of the Heisenberg uncertainty principle in the physical world. That is, they set the limits of what is knowable through perception.

The term "philosophical machine" is introduced by the author to describe machines which extend or facilitate perception and thought. Examples of the former would be, in addition to the usual instruments of observation, machines which alter the time dimension, like the framing camera or devices for time-lapse photography. Examples of machines which aid thought are materialized conceptual models, like Grey Walters turtles, computers used heuristically, or machines whose elemental units are well understood but whose gross behavior is at present not completely predictable, like a neural net mechanism such as the "perceptron." These and other developments associated with information theory and cybernetics appear to the author to contribute to the great dialectics of philosophy another, that of "action vs. communication," which establishes man as a participant in the scientific universe and not simply an appendage of it.

In his bibliography, the author lists his recent book, *Théorie de l'information et perception esthétique*, Flammarion, Paris, 1958, which may be of interest to readers concerned with an information theoretic approach to the psychology of perception.

R. Darrell Bock, Chapel Hill, N. C.

129:

ILLYN, V. A. **Some aspects of cybernetics.** *Cybernetica* **2**, 4 (1959), 203–214.

This is a plea for more research in the field of control systems. Included in this field are the theory of oscillations, information theory, the theory of algorithms, mathematical logic, the theory of games, the theory of tests, and the theory of statistical processes. In describing the field, the author touches on feedback, adaptive machines, and thinking machines.

H. Campaign, Jessup, Md.

AUTOMATIC PROGRAMMING

130:

GILL, S. **Current theory and practice of automatic programming.** *Computer Journal* **2**, 3 (October 1959), 110–114.

This paper is a survey of the current status of automatic programming. The author defines an automatic programming scheme (which he calls an "autocode") as the set of transformations which may be applied to a program before it is in a form for execution by the machine. The author then discusses the purpose of an "autocode" and some modern trends. These include debugging facilities, "squoze" type decks, and other features of monitor or supervisory systems which do not seem to fit his definitions of "autocodes." The author sees, and is in favor of, a trend toward the use of more English language (e.g., using the word ADD instead of the + sign). He gives a figure of 15 to 60 man-years for the development of "autocodes" and rules universities out of the picture. However, this is too pessimistic, since an ALGOL translator was written for the IBM 704 at the University of Michigan in less than two man-years and the reviewer knows of similar achievements at several other universities. The author mentions several areas for further investigation, including: the rules for punctuating and separating expressions; utilization of multi-level storage by "autocodes"; and recursive definitions. It is not clear whether the author's definition of "recursive definition" allows the definition of a new process in terms of itself (e.g., a subroutine which calls on itself). This type of definition is the real problem in providing recursive definition in "autocodes." The paper concludes with a discussion of the idea of a standard language. He points out that the greatest danger is that of reaching a state where future additions are either impossible or extremely clumsy.

Robert M. Graham, Ann Arbor, Mich.

BUSINESS DATA PROCESSING

131:

TAUNTON, B. W. **"Name code", a method of filing accounts alphabetically on a computer.** *Data Processing* **2**, 3 (March 1960), 23–24.

A file of over 900,000 stockholder accounts is maintained by the First National Bank of Boston in alphabetical order on the basis of a 16-character control field placed in each record. The computer itself calculates the control field from the stockholder's name or legal title in which the stock is registered. The basic word in the title is premarked by the typist. Subsequently, the computer proceeds to extract, first from the basic word and subsequently from the other words in the title, the key of 16 alphabetical characters. These characters are chosen as a function of the number of words in the title, ignoring

common words such as "Mr.", "and", "of", etc. The precise algorithm for creating the key is missing from the article. However, two figures illustrate a sufficient number of samples for the reader to deduce the general scheme. In experiments, the bank found that three percent of the keys thus formed were redundant. An "elimination routine" exists for handling such cases. So far, the "Name Code" method has been applied to ten percent of the file. The bank is now proceeding to convert the remainder of the file to this system. This approach to alphabetical filing is considered by the author of the article to be well-suited to low activity files (in this case $\frac{67}{100}$ of 1 percent activity daily). The calculation of the key is relatively slow. A numerical filing system is still advisable for higher-activity files.

Roy Goldfinger, Pound Ridge, N. Y.

132:

SHUCHTER, JEROME P. **Distribution and electronic data processing: "marriage" with problems.** *Computers and Automation* **9**, 3 & 3B (March 1960), 9–14.

The author's honesty in this case study should be applauded; but in spite of this honesty, the initial lack of planning in this company for machine use must strongly be deplored.

The article is well written—its language is interesting; it is not stuffy. The author makes a good point with his example of how "Sam O'Toole" solves production and distribution problems not with a system but by his personal attention. But the article does not hint how a computer could solve it as well. The "marriage" problem seems that the "mechanical (computer) system" was not oriented toward the problems of "reality" illustrated by the example.

The problem presented seems more one of *changing* the procedures than *mechanizing* them. For example, the stock allocation problem discussed is not one of mechanization; the machine solution finally evolved depended as much on proper inventory policies as on their mechanization. Incidentally, if you really "*never* lose a sale for lack of inventory," an objective suggested by the author, then it can be shown that you have too much inventory.

The three errors reported—the pedestal error, the leave-it-to-experts error, and the remote control error—are worthwhile noting. The corrective steps taken seem sound as far as they go. Again, we applaud the author's honesty in revealing that these apparently obvious errors are still (indeed, often!) made. But the suggestion that the planning ought to involve someone with experience and ability in solving organization-versus-computer problems is still lacking. The absence of this guy might have been the cause of most of the problems; his presence might remove entirely some of the "realities of the moment" that this application faced.

The development of one's own experts may not be the fastest way to get them, nor can we ever expect the time "when the machine proves its ability to make decisions as good or better than the distributor himself." The au-

thor's suggestion that *machines* have "know-how" is perhaps unfortunate. His further suggestion that machines will learn if we wait long enough is also disturbing. Let's get people who know something about machines, company operations, and the "marriage" itself, to "teach" them. This lively article is useful as far as it goes, but the fact that it stops short of good system design makes it less useful than otherwise.   *John Postley*, Santa Monica, Calif.

133:

● DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RE-SEARCH. **Wage accounting by electronic computer.** Her Majesty's Stationery Office London, 1956, 55 pp. 2s. 6d.

The steps required to have an electronic computer process a weekly payroll (3,400 employees) by the file maintenance method are described. At the time of writing, there were no computers built in England available for business data processing and the description here assumes that DEUCE, equipped with magnetic tapes, would be used. Brief sections on automatic computers, on the current method of preparing the payroll, on sorting and on reliability are included. There is a careful costing of all stages of the operation. The current method is estimated to cost £12,700 p.a. The computer cost would be £16,200 but there would be ample time for other work, e.g., the monthly payroll for a staff of 19,000; if the computer were fully occupied, the cost on a pro rata basis is estimated as £2,700.   *C. C. Gotlieb*, Toronto, Ont., Canada

134:

MILLER, CECIL. **Work measurement in a data processing system.** *Data Processing* **2**, 2 (February 1960), 22–24 + 37.

This article is a brief description of the establishment and use of time standards in a punched card installation. It is general in nature. Actual examples and copies of reports or forms are not shown. The author gives the reasons for the time standards and the steps that were taken in establishing and implementing them. He also discusses the use of the standards for measuring and the obtaining of other benefits. This article should be of interest to managers of punched card installations and may be applicable for EDP.   *Kendall R. Wright*, Los Angeles, Calif.

135:

SALTON, GERARD. **A new method for the payment of bills and the transfer of credit.** *J. Assoc. Comput. Mach.* **7**, 2 (April 1960), 140–149.

A concept for the payment of bills receivable records is described. This concept differs from the one in popular use today in this country, primarily with respect to the payer. The essence of the system is that the *bill* issued by the payee is preauthorized as a *check* by the payer. When this bill is sent by the payee to his own bank and then to the payer's bank, this makes a bank check by the payer unnecessary. The author claims that this system

eliminates much of the processing now required by both payee and payer. The system is said to be in operation in some banks, although the article still refers to it in a conditional tense.

The usefulness of this paper is limited by one major factor: It focuses its attention on simplifying the *procedures for paying bills* without adequate consideration of the impact of this simplification or the *total financial record keeping job*. Several examples of this will serve to describe the article further.

Dr. Salton contends that the payee can be credited by his bank with the amount of the bill as soon as his bank receives the bill and *before the check has been paid by the payer bank*. This is not cash parting as we know it today. The author further asserts that the payee can assume that when he issues a bill to the payer's bank it will be paid, and hence that the payee can increase his cash records accordingly. This procedure, possible but unused today, would seem even more questionable if the proposed system were widely used in the future. Further, it would seem wise to include in an assessment of the value of this system to a payee firm, an estimate of the costs of the exceptional procedures which it might require. These costs might prove the dominating ones in the entire evaluation. A final and even more poignant difficulty is that of the payer in reconciling his own books with those of the bank if the document which caused the decrease in the bank's balance has not yet reached him.

A substantial disregard for the accounting requirements of some of the agencies involved limits this well-written article to a thought-provoking piece rather than a practical proposal.   *John A. Postley*, Santa Monica, Calif.

136:

O'KEEFFE, WILLIAM H. **Material coding for data processing.** *Data Processing* **2**, 2 (February 1960), 20–21.

This brief article illustrates one approach to the problem of re-coding information as part of a changeover from a manual to an automatic data processing system. In this instance, use of unsuitable formats and non-standard characters in the manual codes for materials inventory forced revision of the system. English words, Greek letters, and proper fractions were discarded in favor of coded representations in letters and decimal digits, and decimal fractions replaced proper fractions. As much as possible of the manual system was retained to minimize need for relearning.

There are no unique aspects to the application presented. The article is of interest only as an illustration of one type of problem encountered in the changeover from a manual to an automatic system. The reader interested in coding systems will want to review the much more systematic approach contained in Edward G. Koch, ("Managerial Strategy Through Classification and Coding," *California Management Review*, **1**, 4 (Summer, 1959), 56–66).   *Richard H. Hill*, Los Angeles. Calif.

137:

DOUGLAS, R. C. **Integrated reservations network.** *Univac Review* **2,** 3 (Fall 1959).

The two page article, well packed with facts, describes a teleprocessing system in which approximately 200 special purpose keysets, distributed among thirteen cities, communicate with a centrally located, medium speed, general purpose, digital computer for the purpose of using a common inventory of airline reservations. The article describes briefly the functional operation of the keyset and the communications system. There is also a general description of the computer program, the response times and the work capacity of the system. The 100-word per minute communication lines are furnished by A. T. and T. Co. All other equipment is furnished by Remington Rand Univac. *R. A. McAvoy*, New York, N. Y.

138:

U. S. ARMY SIGNAL SUPPLY AGENCY. **An evaluation of equipment for expansion of data processing facilities.** *Data Processing* **2,** 3 (March 1960), 17–22.

This is a well organized approach to the problem of choosing among the numerous alternatives when the time arrives to replace or expand data processing facilities. The material presented should enable similar studies to be made faster and more efficiently. It is *not* concerned with machine specifications, but presents a general method which can be used in the decision-making process under consideration. *John W. Hamblen*, Lexington, Ky.

139:

BENDER, B. K.; AND GOLDMAN, A. J. **Analytic comparison of suggested configurations for automatic mail sorting equipment.** *J. Research Nat'l Bureau Stand.* **63B,** 4 (Oct.–Dec. 1959), 83–104.

This article reports the results of an operations research study of the economical organization of certain mail-sorting equipment. Four different sorting schemes are evaluated by comparing a calculated cost to a theoretic minimum cost. This minimum cost, which is unattainable in practice, is a lower bound on the variable costs.

The sorting systems under consideration are made up of two kinds of components: 30-bin modules and loading complexes. Costs are assigned to these components, to floor space, and to personnel. A mail distribution is assumed, based upon the actual distribution of outgoing mail from Los Angeles, but slightly modified to suit the subsequent analysis. Considerable space is then devoted to obtaining the lower bound on cost, taking into consideration both the volume of mail (1 million letters per hour) and its distribution (1,600 destinations arranged in order of decreasing probability).

The four sorting schemes are: the Simplex Scheme, the Christmas Tree Scheme, the Residue Scheme, and Multiple Input Schemes. In the Simplex Scheme, each loading complex is associated with 1,600 bins and a sufficient number of such sub-systems (28) is provided to handle the

1 million letters per hour. The cost of such a scheme turns out to be 162% above the minimum for the case considered. In the Christmas Tree Scheme, the 1,600 destinations are divided into 40 groups of 40 destinations. Two sorts are performed on each letter, first by group then by destination. The cost of such a system is 69% above the minimum for the case considered.

The Residue Scheme requires a division of destinations into two classes, frequent and infrequent. Letters to frequent destinations are sorted immediately to a pocket corresponding to that destination; the balance are placed in a residue pocket for subsequent re-sorting. The breakpoint between frequent and infrequent destinations is calculated by taking into account "sweeping" (i.e. pocket-emptying) cost as well as the costs of loading complexes and bins. It turns out that for the case considered, the Residue Scheme has an excess cost of 8%.

In Multiple Input Schemes "the sorting system consists of a number of identical sub-systems, each receiving its input from a number of loading complexes arranged in series." After some heuristic reasoning to the conclusion that straight Multiple Input Schemes are generally inefficient, a combination scheme, Multiple Input and Residue with Double Loading, is presented. This scheme consists of sub-systems, each of which has two loading complexes. Destinations are divided into three types. The first loading complex of each sub-system sorts type 1 letters into individual pockets and type 3 letters into residue pockets, ignoring type 2 letters. The second loading complex sorts type 1 and 2 letters into individual pockets and type 3 letters into residue pockets. A secondary sorting system is then provided to re-sort the type 3 letters into indvidual pockets. The optimum dividing points between the classes are derived, and it is shown that the excess cost of this system is about 4 percent. Other organizations of equipment could be considered, but it is felt that this last case is so close to the theoretical lower bound of cost that further effort would not be worth while.

It can be seen from the above summary that the subject matter is rather specialized. No diagrams are provided, and an outsider to post office problems might have some difficulty in orienting himself to the nomenclature. The Post Office Department is engaged in a major program of automatizing its operations which will eventually require a vast amount of plant engineering. The work reported here offers a model for future designers in this field. *Sander Rubin*, East Orange, N. J.

COMPUTERS AND EDUCATION

140:

● GRABBE, E. M.; RAMO, S.; AND WOOLDRIDGE, D. E. **Handbook of automation computation and control, vol. 2.** John Wiley & Sons, New York, 1959, $17.00.

Volume 2 is subtitled *Computers and Data Processing* and is divided into 6 parts. Part A, "Computer Terminology," is quite short and requires no comments. Part B, "Digital Computer Programming," by J. W. Carr III, is a book in itself of 270 pages. It is the only adequate discussion in print of the ideas and current state of affairs in the field of automatic coding, and is well worth the price of the book. Most books on coding never do more than touch on the present state of the art of automatic coding, while Carr, who knows what he is talking about, really gives the reader the full treatment in a clear, simple style.

Part C, "The Use of Digital Computers and Data Processors," is a somewhat superficial account of the business applications, from preliminary studies, selecting equipment, and installation problems, to detailed examples of various applications. Here, for the first time in the two volumes so far issued, this reviewer found long stretches of vague generalities having little real content—but that seems to be an inevitable part of writing on the complex subject.

Part D, "Design of Digital Computers," is modern and up to date though the reader finally tires of reading again and again about the conversion from binary to decimal and back (perhaps the only example of poor editing to be found in the entire series).

Part E, "Design and Application of Analog Computers," is a good job, though here there are computing texts covering much the same ground about as well.

The last part, F, "Unusual Computer Systems," is quite short and not very exciting, covering, essentially, mixed analog-digital systems and Turing machines.

In summary, Vol. 2, after an excellent start in Automatic Coding, ends up somewhat less well done than Vol. 1, but is still well worth the price.

R. W. Hamming, Murray Hill, N. J

DIGITAL COMPUTER PROGRAMMING

141:

HINTZEN, JOSEF. **Die elektronische Berechnung des Durchlauftagers auf starren und elastischen Stutzen** (The electronic calculation of a continuous suspension girder with rigid and elastic supports). *Elektronische Datenverarbeitung* 4 (1959), 31–36. (German)

The author sets up a flow chart for the calculation of a continuous suspension girder, either rigidly or elastically supported. Following S. Falk [*Ingenieurarch* 24 (1956)], the continuous problem is discretized. The state of the girder at each station is represented by a 5-vector (the 5th component is for convenience only). In the major part of the paper a matrix is set up to relate states at successive stations, and a variety of boundary conditions and external forces are provided for. There is a flow chart for a marching (non-iterative) calculation, but no report of machine experience.   *G. E. Forsythe*, Stanford, Calif.

DIGITAL COMPUTER PROGRAMMING (LANGUAGES)

142:

GELERNTER, H.; HANSEN, J. R.; AND GERBERICH, C. L. **A Fortran-compiled list-processing language.** *J. Assoc. Comput. Mach.* **7**, 2 (April 1960), 87–101.

This paper contains an introductory description of FLPL which is an extension of the Fortran Compiler System for the IBM 704. A geometry theorem proving program was written in this language by the authors and D. Loveland. In addition to standard Fortran, FLPL contains a number of list processing functions which are available on library tapes. Examples show how fairly complex symbol manipulation processes are easily coded by nesting and combining these functions according to the rules of Fortran.

FLPL is compared with Newell, Simon, and Shaw's IPL V, an interpretive list processing language for the 704. The advantages of FLPL are the availability of the arithmetic and diagnostic abilities of Fortran as well as higher operating speed of the compiled program. On the other hand, IPL V has the advantage of defining functions recursively and the ability to consider and manipulate sequences of IPL instructions as lists.

Walter Hoffman, Detroit, Mich.

143:

● SATTLEY, KIRK. **Notes on construction of an ALGOL translator.** University of Chicago (IAWR Document 60D4M), Chicago, Ill., 1960, 20 pp.

This paper is the first to come to this reviewer's notice which seriously tackles the problem of how compilers are, or ought to be, constructed. Mr. Sattley sets forth a logical framework adequate to translate ALGOL-58 and illustrates his proposals with a detailed example. The exposition is tight but clear. He discusses a translator which edits, translates to symbolic macros, then symbolically assembles—the latter operation having several levels of possible sophistication. A knowledge of the ALGOL language is essential for the reader, and some prior thought about translators desirable, since this paper is full of detailed—and frequently conflicting—suggestions. It is a good start on a difficult topic.

Forman S. Acton, Princeton, N. J.

DIGITAL COMPUTER SYSTEMS

144:

BAUER, F. L. **The formula-controlled logical computer "stanislaus."** *Mathematics of Computation* **14**, 69 (January 1960), 64–67.

"Stanislaus'" computational vocabulary is limited to formulas of the propositional calculus for which it can, (1) test that the structure is valid and, (2) find the truth (0 or 1) for any given set of truth-values for its variables.

It is limited to formulas of length no greater than 10 symbols which may include 5 different variables and 5 standard operators. It is a relay machine programmed by means of a "full keyboard" of 10 columns, each containing keys for all ten permissible symbols. Truth values are set by means of 5 double-throw switches; outputs appear on signal lights.

The key to the neatness of design of this little machine is in its use of parenthesis-free (or "Warsaw" or "Lukasiewicz's") notation in which, e.g., '$[(p \supset q) \,\& \,(q \supset r)] \supset (p \supset r)$' is written '$CK\ CpqCqrCpr$.' Again, as in the Burroughs Truth-Function Evaluator [BURKS, ARTHUR W.; WARREN, DON; AND WRIGHT, JESSE B. An analysis of a logical machine using parenthesis-free notation. *Math. Tables Aids Comput.* **8**, (1954) 53–57] the mechanizability of this notation is demonstrated.

The exposition is clear and concise; a wiring schematic and keyboard diagram are included.

Don W. Warren, Ann Arbor, Mich.

145:

TAKAHASHI, SHEGERU. **Development of Japanese digital computers.** *Computer Journal* **2**, 3 (October 1959), 122–129.

The development of digital computers in Japan up to early 1959 is described. Except for a few earlier models, which were designed out of electromagnetic relays, most computers are built of the logic circuit called "parametron." This is based on the principle of parametric excitation. Until now, computers constructed via that circuitry have been rather slow in their computation speed. Due to their higher reliability, however, the maintenance appears to be easier than that of computers constructed from the electron tube circuitry. (An excellent paper on the parametron by its inventor, E. Goto, appeared in the August, 1959 issue of *Proc. IRE*.) After a short description on parametrons, a different principle of magnetic core storage is explained, which can be connected to the above-mentioned computers. Other types of computers have been constructed from transistor dynamic circuitries as well, but, there again, the computer speed requires further improvement. A comprehensive list of computers is given, together with a brief description of the individual characteristics as well as their historical development.

Noriyuki Nakagawa, Ossining, N. Y.

MANAGERIAL APPLICATIONS

146:

ARMSTRONG, NEWTON A. **Eventual full automation of pipelines.** *Cybernetica* **2**, 4 (1959), 250–260.

This article is a very general and non-technical exposition on some of the problems associated with the full automation of a pipeline; it appears to be particularly interested in a gas-gathering system. The main premise is the recommendation for a full study of future plans before the investment in any equipment, including interim manual and semi-automatic, in order to insure compatibility. Basic rules are given for the type and amount of data he feels is necessary. Discussion includes the sending of this data to a central control station, including the information needed in accounting functions, the control of this complex of valves and compressors, maintenance and safety controls, and the feedback required for improvement of the operating characteristics. The final portion is a discussion of the four stages incurred when going from a manual to a fully automatic system.

The author recommends that only digital information be transmitted and indicates that a computer should be in the system. He states a need for a "general pipeline computer" for over-all control without definition of the characteristics. At the end of the article, he states this computer ". . . should be specifically designed for the solution of the equations describing the particular pipeline system." At another point he recommends ". . . a special purpose computer is needed to resolve these inter-related variables . . ." associated with the maximization of the profit from this pipeline operation. He pays lip service to the many problems of feedback, computers and control without giving a specific method for solving any particular problem.   *J. G. Steward*, Houston, Texas

147:

MCRAINEY, J. H. **Role of computers in automation.** *Automation* **7**, 3 (March 1960), 48–57.

This article is an exposition of the use of computers for the layman. It describes the processes of preparing a problem for computers, executing it, and, finally, utilizing the results. It describes various kinds of problems and, in essence, does justice to the field. Unfortunately, the reviewer is not in the position of a layman and does not really know whether the article fills the vacuum of lay knowledge, or whether it is just another of a vast number of popularizations.

Alex Bernstein, New York, N. Y.

MECHANICAL LANGUAGE TRANSLATION

148:

KULAGINA, O. S. **Machine translation from French (into Russian).** *LLU Translations Bulletin* (February 1959), 33–40.

The article is a very brief semi-popular description of Kulagina's work on translation from French to Russian. Further descriptions of this work may be found in Vol. 1 and Vol. 2 of occasional journal *Problemy Kibernetiki* (Problems of Cybernetics) and in the review articles by Rozentsveig and by Oettinger in *Mechanical Translation*, **5**, 3 (December 1958).

A. G. Oettinger, Cambridge, Mass.

149:

PANOV, D. YU; LYAPUNOV, A. A. AND MUKHIN, I. S. **Automation of translating.** *LLU Translations Bulletin* (April 1959), 16–40.

This paper summarizes work done at the Institute for Precision Mechanics and Computing Techniques and at the Steklov Mathematical Institute in Moscow, recapitulating several earlier, more specialized papers. More detailed reviews may be found in Rozentsveig's "Machine Translation in the Soviet Union" and Oettinger's "A Survey of Soviet Work on Automatic Translation," both in *Mechanical Translation*, **5,** 3 (December 1958).

A. G. Oettinger Cambridge, Mass.

150:

YEFIMOV, M. B. **The analysis of Japanese in machine translation.** *U. S. Joint Publications Research Service* **1130-D** (January 26, 1960).

The paper describes the machine translation of Japanese scientific (mainly mathematical) papers into Russian. As pointed out in the paper, the program is not sufficient, in general, for the translation of Japanese into Russian, due to the two following reasons: 1) the lack of Japanese-Russian dictionary compilation and, 2) the difference in the Japanese style between literary works and scientific papers.

Within its own limitations, however, it is evident that the program described is a result of extensive study of the subject. Those who are interested in the mechanical translation of Japanese could not possibly neglect the activity in the USSR. Aside from minor ambiguities in the discussion, the paper is well-written and easy to follow. There is an error in the translated paper on p. 5: the English translation of the cited Japanese should read "let us include y instead of x, y_1 instead of x_1."

Noriyuki Nakagawa, Ossining, N. Y.

151:

OETTINGER, ANTHONY G. **A survey of Soviet work on automatic translation.** *Mechanical Translation* **5,** 3 (December 1958), 101–110.

The purpose of this paper is to acquaint "English-speaking workers in the field (of automatic translation) with sources of information about relevant Soviet work." A bibliography of 24 articles on Soviet automatic machine translation and 24 related articles and publications provides a comprehensive list to the date of this paper (December, 1958). The main theme of each article is briefly reviewed, and it is the author's opinion that "serious work of high quality is under way on a significant scale" and that "much of the theoretical work is excellent." From some of the reviews, it is evident that there is a difference of opinion in Russia as to the value of automatic translation; however, it appears that the effort on machine translation is not losing force.

J. H. Brown, Norristown, Pa.

152:

MATTHEWS, G. H. AND ROGOVIN, SYRELL. **German sentence recognition.** *Mechanical Translation* **5,** 3 (December 1958), 114–120.

This article presents a general outline of the methodology used by the M.I.T. machine translation group, headed by Yngve, for the automatic determination of German sentence structure. It is deliberately based upon an immediate constituent model which, as recently shown by Chomsky, is more adequate for the description of natural languages than Markov process models that have served as the basis for prior attempts at automatic recognition of German sentence structure (by Oswald-Fletcher or Booth-Cleave-Brandwood). It should, therefore, be able to produce translations of better quality. The price to be paid is really a greater amount of initial syntactical analysis than required for the procedure essentially based on a word-by-word translation supplemented by ad hoc improvements.

The specific recognition procedure outline recalls the procedures developed by Harris for English, Garvin for Russian, and by various Russian investigators for all these languages. The dictionary contains every German lexical item which one would want to translate, tagged with grammatical information indicating the various form classes to which this item may belong, as well as information specific to this particular item. Each sentence is scanned three times, from beginning to end, back to the beginning and finally again to the end, the first scan yielding primarily the location of the finite verb, the second scan isolating the dependent constructions, and the final scan identifying the various noun phrases and prepositional phrases and establishing their possible functions. The authors do not claim that their program can recognize all German sentences and even give some examples for which their program in its present state would fail. In view of the fact, however, that the presentation of the program, clear and concise as it is, is not sufficiently detailed, it is difficult to judge its exact scope, and various questions which one could raise—and which are answered, at least partially, in the incomparably more detailed procedures worked out by Harris, for instance—remain unanswered.

It is somewhat disturbing that the authors seem to use the term "immediate constituent structure" in various senses which are not as clearly distinguished as they should be. This term seems to refer sometimes to what Chomsky calls "context-free phrase structure grammars," sometimes to the more general and less explored "context-dependent phrase structure grammars," and, on one occasion, the authors mention that "the recognition process must take into account generation rules which delete, rearrange, expand, and reclassify constituents in the sentence," i.e. procedures belonging to what Chomsky calls transformational grammars. Strangely enough, the authors never come back to this point, and their

procedures seem to be tailored for context-free phrase structure models only. The problems created, for instance, by so-called discontinuous constituents, clearly recognized and treated by Yngve himself in recent investigations, are not mentioned. It is therefore unlikely that the limitations of the authors' procedures "do not represent an inherent weakness in the system, though some of them do exemplify the results of optional transformations which we have not yet treated." Others are probably due to the fact that the immediate constituent grammars of the simplest forms are just not adequate enough as a model for high quality automatic determination of sentence structure.

Yehoshua Bar-Hillel, Jerusalem, Israel

153:

Rozentsveig, V. Yu. **The work on machine translation in the Soviet Union.** *Mechanical Translation* **5,** 3 (December 1958), 95–100.

The article is a review of the work being done in translation between Russian and numerous other languages. There is ample discussion of what is being done on the problem although little information about how it is being accomplished is given. Two basic approaches are mentioned. The first one involves construction of dictionaries and sets of rules for performing the translation. The second method is a more formal approach which attempts to use mathematical logic and set theory. Several references to more detailed papers are given.

Fred R. Dornheim, Harvey, Ill.

154

Hays, D. G. **Order of subject and object in scientific Russian when other differentia are lacking.** *Mechanical Translation* **5,** 3 (December 1958), 111–113.

In a sample of 22,000 words of Russian physics text, the author considered 100 cases of verbs with two dependents where either noun could be the subject. Fifty-six cases were truly ambiguous. Human judgment was used to determine the subject word and object word. A chart shows the kinds of cases, frequency of occurrence, and word order determined. In 52 of the 56 cases, the order is Subject-Verb-Object. In the remaining 4 cases, the order is Verb-Object-Subject. It would appear worthwhile to extend this preliminary study to a larger sampling to determine whether the rule of word order can be reliably used to resolve instances where subject and object are morphologically indistinguishable.

Judith Levenson, Lexington, Mass.

155:

Sofronov, M. V. **The general principles of machine translation from the Chinese language.** *Voprosy V Yazykoznaniya*, **3,** 2 (1958), 116–121. (Russian)
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 170)

156:

Parker-Rhodes, A. F. **The use of statistics in language research.** *Machine Translation*, **5,** 2 (1958), 67–73.
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 171)

157:

Korolev, L. N. **Method of selecting the required words from the dictionary.** *U. S. Soviet Publication Research Service 487-D* (January 16, 1959), 28–30. (English translation).
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 172)

158:

Kulagina, O. S. **Machine translation from French.** *Izvestiya Vysshikh Uchebnykh Zavedenii, Matematika,* **5** (1958), 46–51.
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 173)

159:

Brandwood, Leonard. **Some problems in the mechanical translation of German.** *Mechanical Translation*, **5,** 2 (1958), 60–66.
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1953), Biblio. 174)

160:

Newman, S. M.; Swanson, R. W.; and Knowlton, K. C. **A notation system for transliterating technical and scientific texts for use in data processing systems.** *Patent Office Research and Development Reports,* No. **15** (1959).
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 175)

161:

Kulagina, O. S. **The operator description of translation algorithms.** *Mashinnyi Perevod i Prikladnaya Lingvistika* (Machine Translation and Applied Linguistics), **2,** 9 (1959). (Russian)
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 175)

162:

Nikolaeva, T. M. **Soviet developments in machine translation: Russian sentence analysis.** *Mechanical Translation*, **5,** 2 (1958), 51–99.
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 177)

163:

Cooper, William S. **The storage problem.** *Mechanical Translation*, **5,** 2 (1958), 74–83.
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 179)

164:

Reuben, A. Brower, Editor. **On Translation.** Harvard University Press, Cambridge, Mass. (1959).
(Reviewed in *Mechanical Translation*, 5, 3, (Dec. 1958), Biblio. 180)

MEDICAL AND PSYCHOLOGICAL APPLICATIONS

165:

VANDENBERG, S. G.; GREEN, BERT F.; GALLER, BERNARD A.; AND WHITE, B. W. **Computers in behavioral science.** *Behavioral Science* 4, 2 (April 1959), 163–172.

"Computers in Behavioral Science," is a new regular department of *Behavioral Science*. Steven G. Vandenberg is Chairman of the Editorial Committee responsible for this department. This department is to carry computer program abstracts, brief descriptions of integrated data processing systems, and technical papers on all aspects of computer usage and techniques—concentrating on items of special interest to behavioral scientists.

This first issue from the new department includes three short technical notes, each written for the behavioral scientist with little or no computer experience: 1) "Some thoughts about possible changes in research practices resulting from the use of electronic computers" (S. G. Vandenberg); 2) "Noncomputational uses of digital computers" (B. F. Green, Jr.); 3) "Some remarks on linear programming" (B. A. Galler). There are also several news items, including an announcement that the Varimax method of factor rotation, due to A. F. Kaiser, has been programmed for the IBM 650 by Vandenberg and Lamphiear.

This new department of *Behavioral Science* should be followed by all who are interested in keeping abreast of new computer developments of special interest to the behavioral sciences.

Merrill M. Flood, Ann Arbor, Michigan

NON-NUMERIC APPLICATIONS

166:

KILLGROVE, RAYMOND B. **A note on the nonexistence of certain projective planes of order nine.** *Mathematics of Computation* 14, 69 (January 1960), 70–71.

Using a card sorter and the SWAC, an exhaustive search was run for projective planes of order 9 having the cycle group of order 9 as additive loop in the ternary ring. It was found that no such plane exists. Use was made of automorphisms of the group, and of the technique of preferences, to cut down the size of the search. The work parallels that of Hall, Swift, and Killgrove (*MATC*, 13, (1959), 233–246). *E. T. Parker*, St. Paul, Minn.

NUMERICAL MATHEMATICS

167:

WYNN, P. **A sufficient condition for the instability of the q-d algorithm.** *Numerische Mathematik* 1, 4 (September 1959), 203–207.

The Q-D algorithm of Rutishauser may be used to obtain a continued fraction representation for a formal power series $\sum_{r=0}^{\infty} c_{m+r} z^{-r-1}$. This process is said to be unstable if errors in the c's induce ever-increasing relative errors in the coefficients of the continued fraction. The author derives a sufficient condition for instability of the Q-D algorithm and exhibits three examples for which this condition is satisfied.

Misprints noted: in the first row of determinant (12), read c_m, $c_{M\cdot 1}$, $\cdots$; in the second row, read c_{m+1}, c_{m+2}, $\cdots$; in equation (4), replace the last occurrence of $e_r^{(s)}$ by $e_r^{(s+1)}$. *Samuel Conte*, Los Angeles, Calif.

168:

STRUBLE, GEORGE. **Tables for use in quadrature formulas involving derivatives of the integrand.** *Mathematics of Computation* 14, 69 (January 1960), 8–12.

This paper gives tables of a_j and x_j for use in the quadrature rules (1), (2) developed by Hammer and Wicke [cf. Review No. 169] for $k = 1, 2$, $m = 1(1)10$. Coefficients of the related orthogonal polynomials $P_{m,k}$ and values of $C_{m,k}$ are also tabulated. The $P_{m,k}$ were generated by orthonormalizing the sequence 1, x, $\cdots$, x^m with the corresponding weight function and then solving a set of linear equations. This method of generating the coefficients of $P_{m,k}$ leads to ill-conditioned matrices as was pointed out by Forsythe [J. SIAM 5, (1957) 74] and hence the error builds up as m increases to the extent that for $m = 10$ only 9 digits were certain even though an 18-digit floating-decimal point interpretive routine was used. This is especially distressing since more accuracy is desired as we increase m. The use of the three term recursion formula for the $P_{m,k}$ given by Hammer and Wicke would have avoided this difficulty and should be used in the future if it is found desirable to extend this table in either direction. *Philip Rabinowitz*, Washington, D. C.

169:

HAMMER, PRESTON C.; AND WICKE, HOWARD H. **Quadrature formulas involving derivatives of the integrand.** *Mathematics of Computation* 14, 69 (January 1960), 3–7.

The authors derive the following integration rules:

$$\int_{-1}^{1} f(x)\, dx = 2 \sum_{i=0}^{(k-1)/2} \frac{f^{(2i)}(0)}{(2i+1)!}$$

$$(1) \qquad + \sum_{j=1}^{m} a_j [f^{(k)}(x_j) - f^{(k)}(-x_j)]$$

$$+ \frac{f^{(4m+k+1)}(n)}{(4m+1)!} C_{m,k} \quad \text{for } k \text{ odd.}$$

$$\int_{-1}^{1} f(x)\, dx = 2 \sum_{i=0}^{(k-2)/2} \frac{f^{(2i)}(0)}{(2i+1)!}$$

$$(2) \qquad + \sum_{j=1}^{m} a_j [f^{(k)}(x_j) + f^{(k)}(-x_j)]$$

$$+ \frac{f^{(4m+k)}(n)}{(4m)!} C_{m,k} \quad \text{for } k \text{ even.}$$

The x_j are the square roots of the zeros of a sequence $P_{m,k}(u)$ of polynomials orthogonal in $[-1, 1]$ with respect to the weight functions $(1 - \sqrt{u})^k$ (k odd) and $(1 - \sqrt{u})^k/\sqrt{u}$ (k even), for which a recursion formula is developed. These formulae are useful where the derivatives of a function are easier to compute than the function as in the case where the integrand is a variable integral and in the numerical solution of differential equations.

Philip Rabinowitz, Washington, D. C.

170:

Rabinowitz, Philip. **Abscissas and weights for Lobatto quadrature of high order.** *Mathematics of Computation* **14,** 69 (January 1960), 47–52.

Abscissas and weights associated with Lobatto quadrature have been calculated on the WEIZAC computer to 19 decimal places. These numbers are tabulated over the normalized interval $(-1, 1)$ and are given for the n-point integration, $n = 5(4)25(8)49(16)65$. Additional data for $n = 81, 97$ are available through the Unpublished Mathematical Tables File.

This quadrature procedure is exact for polynomials up to degree $2n - 3$ whereas Gaussian quadrature is exact for polynomials up to degree $2n - 1$. However, the advantage of the former is the inclusion of the end points of the interval of integration in the set of abscissas.

Four checks were made to guard against computer errors and transcription errors.

Werner L. Frank, Los Angeles, Calif.

171:

Wilkinson, J. H. **The evaluation of the zeros of ill-conditioned polynomials. Part 1.** *Numerische Mathematik* **1,** 3 (July 1959), 150–166.

The author discusses polynomials which are ill-conditioned in the sense that their zeros are considerably altered by relatively minor changes in their coefficients. He asserts that such ill-conditioning cannot be overcome except by resort to high precision computation, although such computation may be held to a relatively small percentage of the total by properly chosen solution methods. Among others, the 20th degree polynomial with roots $-1, -2, \cdots, -20$ is exhibited to show that ill-conditioning is not necessarily associated with closeness of roots. The author's experience suggests that matrix eigenvalues may often be expediently computed via the characteristic polynomial even if double precision arithmetic is required. Bairstow's and Müller's techniques for zeros are presented and several programs available on the DEUCE computer are described. The paper is a useful compendium of advice in a difficult area.

Forman Acton, Princeton, N. J.

172:

Isemanger, K. R. **The complete factorization of 2^{132} plus 1.** *Mathematics of Computation* **14,** 16 (January 1960) 73–74.

This is a short paper which describes briefly the method

used to factor $2^{132} + 1$. The main problem was to factor N where

$$2^{132} + 1 = (17)(241)(353)(7393)(2931542417) \times N.$$

The two factors of N turn out to be 17613 45169 and 9 86182 73953. The SILLIAC computer at the University of Sydney was used to verify the primality of these two factors. *R. Wonderly*, Chapel Hill, N. C.

173:

Gillis, Joseph; and Weiss, George. **Products of Laguerre polynomials.** *Mathematics of Computation* **14,** 69 (January 1960), 60–63.

If the product of two Laguerre polynomials is expressed as a series of Laguerre polynomials, the coefficients of the series may be found by a formula previously given by Watson [*London Math. Soc. Journ.* **13** (1938), p. 29]. A simple derivation of this formula is given and two recurrence relations satisfied by the coefficients are obtained.

Albert A. Grau, Oak Ridge, Tenn.

174:

Alonso, R. **A starting method for the three-point Adams predictor-corrector method.** *J. Assoc. Comput. Mach.* **7,** 2 (April 1960), 176–180.

The author shows that the three-point Adams formula:

$$y_{n+1} = y_n + h[5f(t_{n+1}, y_{n+1})$$
$$+ 8f(t_n, y_n) - f(t_{n-1}, y_{n-1})]/12$$

for continuing the numerical solution of the differential equation $y' = f(t, y)$ leads to a method which may be considered "self-starting" in the sense that minor modifications of the method provide starting values of sufficient accuracy for continuing the solution. The initial value $y_0 = y(t_0)$ is assumed given and starting values $\bar{y}_{+1}$ and $\bar{y}_{-1}$ are obtained as limits of sequences $\{y_{+1}^{(i)}\}$ and $\{y_{-1}^{(i)}\}$ whose terms are defined iteratively by the scheme:

$$y_{+1}^{(i)} = y_0 + h[5f(t_{+1}, y_{+1}^{(i-1)}) + 8f(t_0, y_0)$$
$$- f(t_{-1}, y_{-1}^{(i-1)})]/12$$
$$y_{-1}^{(i)} = y_0 - h[5f(t_{-1}, y_{-1}^{(i-1)}) + 8f(t_0, y_0)$$
$$- f(t_{+1}, y_{+1}^{(i-1)})]/12$$

where $y_{+1}^{(0)} = y_{-1}^{(0)} = y_0$. (The author's use of two superscripts i and j seems unnecessarily cumbersome.)

For sufficiently small values of h the iterative process converges. Moreover, if y_{+1} is the value of y at $x_0 + h$ that would be obtained from the three-point Adams formula assuming y_{-1} is given exactly, then for small h the difference $|\bar{y}_{+1} - y_{+1}|$ is a small percentage of the single step truncation error associated with the method.

Unfortunately, there are several algebraic and typographical errors. In particular, it seems to the reviewer that the convergence conditions (8) should read

$$\left| 5h(g_{+1} - g_{-1}) \pm h[25(g_{+1} + g_{-1})^2 - 4g_{+1}g_{-1}]^{1/2} \right| < 24$$

and that equations (17) and the estimate (18) for the difference $\bar{y}_{+1} - y_{+1}$ should be

$$\Delta = [T_{-1}\gamma_{-1}(1 - 5\gamma_1) + \gamma_1\gamma_{-1}T_1]$$

$$/[(1 - 5\gamma_1)(1 + 5\gamma_{-1}) + \gamma_1\gamma_{-1}](1 - 5\gamma_1)$$

$$|\Delta| \leqq |[\gamma(1 + 6\gamma)T]/[(1 - 10\gamma + 24\gamma^2)(1 - 5\gamma)]|,$$

respectively. *Ottis W. Rechard*, Pullman, Wash.

175:

COHN, HARVEY. **Numerical study of the representation of a totally positive quadratic integer as the sum of quadratic integral squares.** *Numerische Mathematik* **1**, 3 (July 1959), 121–134.

Quadratic integers are numbers of the form $\alpha = (a + bm^{1/2})/f$, $a \equiv b \pmod{f}$, where a and b are integers, m is a square free positive integer, and $f = 1$, $m \not\equiv 1 \pmod 4$; $f = 2$, $m \equiv 1 \pmod 4$. If in addition, $f^2a^2 > 4b^2m$, $a > 0$, $b \geqq 0$, then α is a totally positive quadratic integer. The paper describes a series of experiments with an automatic computer on the representation of a totally positive quadratic integer as a sum of quadratic integral squares. The problem investigated was one of finding the minimum number of squares, Q, required for such a representation. If no such squares exist, Q is taken to be zero. The numerical evidence indicates that a totally positive quadratic integer can be represented either as a sum of five or fewer squares or else no number of squares will suffice. A more precarious conjecture is also made that when $m \not\equiv 1 \pmod 8$ three squares will suffice provided the norm, $N(\alpha) = (a^2 - b^2m)/f^2$ is large. The results of some of the exceptional cases ($Q = 0$, $Q = 5$, and $m \equiv 1 \pmod 8$) are explained using elementary number theory.

Charlotte Froese, Vancouver, B.C., Canada

176:

MORRISON, DAVID D. **Remarks on the unitary triangularization of a nonsymmetric matrix.** *J. Assoc. Comput. Mach.* **7**, 2 (April 1960), 185–186.

This paper is an unnecessarily complicated extension of a paper of Householder's [A. Householder, Unitary triangularization of a nonsymmetric matrix, *J. Assoc. Comp. Mach.* **5** (1958), 339–342] and is correct in its implication that Householder's paper is not valid for the complex case. Both papers have sloppy proofs in tacitly assuming a vector in the proof of its existence. Both Lemmas can be replaced by the simpler

LEMMA. Let a and v be non-zero vectors such that $a * v$ is non-positive real and $v * v = a * a$, the $u = a - v$ satisfies: i) $a * a \leqq u * u \leqq 4a * a$; ii) the matrix $U = I - (2/u * u)uu*$ is unitary; and iii) $Ua = v$. i) and ii) are readily verified, and using $u * u = a * a - 2a * v + v * v = 2a * a - 2a * v = 2a * u$ we have $Ua = a - (2u * a/u * u)u = a - (a - v) = v$. In applying the Lemma as in [1], one simply chooses v to be a multiple of e_1, the first column vector of the identity, satisfying the hypotheses of my simpler Lemma. With this choice of v,

the Lemmas of both papers reduce to the one here. The author's remarks on numerical accuracy are apt but also apply to the vector u. Applying both Lemmas to the matrix $A = \begin{pmatrix} 1 & 0 \\ \epsilon & 1 \end{pmatrix}$ using single precision arithmetic, where $\epsilon \neq 0$, is so small that ϵ^2 behaves like zero when added to 1, then the Lemma of [1] states that A is upper triangular. *Richard E. von Holdt*, Livermore, Calif.

177:

FLINN, E. A. **A modification of Filon's method of numerical integration.** *J. Assoc. Comput. Mach.* **7**, 2 (April 1960), 181–184.

The paper deals with integrals of the form $\int_A^B f(x) \cos px \, dx$ and $\int_A^B f(x) \sin px \, dx$. Filon's method, which uses Simpson's rule, is modified by replacing the second-order parabola by a fifth-order curve which fits $f(x)$ with a Lagrange-Hermite type of approximation.

The advantage of such a method is greatest for analytically given functions or functions which are obtained from a differential equation, i.e. whenever the derivative is known with sufficient accuracy. In these cases the error of the integration is considerably reduced as compared to Filon's method applied to the same number of subintervals of width $2h$.

The author gives formulae for the coefficients and their expansions in powers of ph. The latter expansions are to be preferred for $ph < 0.9$.

The method is illustrated by a well-tailored example: $\int_{0.5}^{1.5} e^x \cos \pi x \, dx$. The error compares very favorably with the one obtained by using Filon's method with 1, 2 and 5 subintervals of width $2h$.

No general error estimates are given. In particular the dependence of the error upon p should be of great interest. The fact that $f'(x)$ has to be known with the same accuracy as $f(x)$ makes the method ill-suited for numerically given functions. In that case there may or may not be a gain of accuracy over Filon's method.

Hansjorg Oser, Washington, D. C.

178:

DIJKSTRA, E. W. **A note on two problems in connexion with graphs.** *Numerische Mathematik* **1**, 5 (October 1959), 269–271.

The two problems, constructing a tree of minimum total length between n nodes and finding a path of minimum total length between two given nodes, have received wide attention during the past few years because of their applicability to a variety of practical problems suitable for computer programming. As a variation to the solution of each of the two problems the author offers an algorithm designed to minimize the requirements of internal computer storage of data. Unknown to the author, a similar algorithm to the first problem had already been presented earlier by R. C. Prim [Prim, R. C. Shortest Connection Networks and Some Generalizations, *Bell System Technical Journal* **36**, 6 (November 1957), 1389–1401.

Arnold Weinberger, Silver Spring, Md.

179:

Givens, W. J. **The linear equations problem.** *Stanford University Technical Report* **No. 3** (December 1959).

The author describes a specific technique for solving the linear equations problem in the general form $AX = BY + C$. Special attention is given to the use of magnetic tapes as the auxiliary store.

The equations are solved by reduction to triangular form using a sequence of plane rotations, the matrix (A, B, C) being processed column by column. The processing of any column requires information specifying the rotations used in previous columns and this is held in the high speed store as long as it is adequate. When the storage space is exhausted the remaining columns are subjected to the stored rotations which are then no longer required. The reduction then continues as before. From the triangularised matrix the compatibility of the equations is assessed and, if they are compatible, the general solutions are obtained by back-substitutions. Experiments carried out on UNIVAC and the ORACLE are described. The results show the method to be one of the more accurate of direct methods and it has the advantage that a simple preliminary scaling suffices. The reader may wish to compare this paper with that by Barron and Swinnerton-Dyer (*Computer Journal* **3**, 1) which describes how to adapt the elimination method for tape storage.

J. H. Wilkinson, Teddington, England

180:

Longman, I. M. **A method for the numerical evaluation of finite integrals of oscillatory functions.** *Mathematics of Computation* **14,** 69 (January 1960) 53–59.

This paper is a continuation of two earlier ones by the same author on the numerical evaluation of integrals of oscillatory functions. The first two papers were based on a direct application of Euler's transformation for accelerating the convergence of infinite series, and the adaptations presented were most naturally applicable to integrals of oscillatory functions having an infinite number of changes of sign. The goal of this paper is to present a method specifically designed for cases in which the integrand has a large but finite number of changes of sign. Mathematically this paper is somewhat more sophisticated than the two earlier ones in that an extension of Euler's transformation is obtained by the use of Abel's summability device.

Evaluation of integrals of the type under consideration can be thought of as the calculation of sums of series of the form

(1) $\quad S = v_0 - v_1 + v_2 - \cdots + (-1)^n v_n$.

Let

$$S(x) = v_0 - v_1 x + v_2 x_2 - \cdots + (-1)^n v_n x^n.$$

Then

$$(1 + x)S(x) = v_0 - (v_1 - v_0)x + (v_2 - v_1)x^2 - \cdots$$
$$+ (-1)^n(v_n - v_{n-1})x^n + (-1)^n v_n x^{n+1}.$$

Therefore

$$S(x) = [v_0 + (-1)^n v_n x^{n+1}]/[1 + x] - y[\Delta v_0 - (\Delta v_1)x$$
$$+ (\Delta v_2)x^2 - \cdots + (-1)^{n-1}(\Delta v_{n-1})x^{n-1}]$$

where $y = x/(1 + x)$. Obviously the bracketed series can be treated in the same way as the original expression for $S(x)$. Repeating the process p times ($p \leq n$) and setting $x = 1$, we get

$$S = [(\tfrac{1}{2})v_0 - (\tfrac{1}{4})\Delta v_0 + (\tfrac{1}{8})\Delta^2 v_0 - \cdots$$
$$+ (-1)^{p-1}2^{-p}(\Delta^{p-1}v_0)] + (-1)^n[(\tfrac{1}{2})v_n + (\tfrac{1}{4})\Delta v_{n-1}$$
$$+ (\tfrac{1}{8})\Delta^2 v_{n-2} + \cdots + 2^{-p}\Delta^{p-1}v_{n-p+1}]$$
$$+ 2^{-p}(-1)^p[\Delta^p v_0 - \Delta^p v_1 + \Delta^p v_2 - \cdots + (-1)^{n-p}\Delta^p v_{n-p}].$$

When p and n are large and higher order differences are small, the following good approximation is obtained from the above

$$S = (\tfrac{1}{2})v_0 - (\tfrac{1}{4})\Delta v_0 + (\tfrac{1}{8})\Delta^2 v_0 - \cdots + (-1)^n[(\tfrac{1}{2})v_n$$
$$+ (\tfrac{1}{4})\Delta v_{n-1} + (\tfrac{1}{8})\Delta^2 v_{n-2} + \cdots$$

Impressive experimental results obtained with the use of this approximation are included.

Robert W. Mann, Chapel Hill, N. C.

181:

Bertram, G. **Eine fehlerabschätzung für gewisse selbstadjungierte, gewöhnliche randwertaufgaben** (An error estimation for certain self-adjoint, ordinary boundary value problems). *Numerische Mathematik* **1,** 4 (September 1959), 181–185. (German)

Let $v(x)$ be an approximate, $u(x)$ an exact, solution of the boundary value problem

$$L[y] = \sum_0^m (-1)^\mu [p_\mu(x)y^{(\mu)}(x)]^{(\mu)} = r(x),$$
$$y^{(\mu)}(a) = y^{(\mu)}(b) = 0, \qquad \mu = 0, 1, \cdots, m - 1,$$

with suitable continuity properties. Then, independently of the method of solution,

$$\max_x |v(x) - u(x)| \leq A \int_a^b |L[v] - r| \, dx,$$
$$Ap(2m - 1)[(m - 1)!2^m]^2 = (b - a)^{2m-1}.$$

The usual error bound relates to a particular method of solution. *A. S. Householder*, Oak Ridge Tenn.

SCIENTIFIC AND ENGINEERING APPLICATIONS

182:

● Epstein, L. Ivan. **Nomography.** Interscience Publishers, New York, 1958, 10–134 pp., $4.50.

Nomography occupies an anomalous position in computing circles; most people are only vaguely aware of it, and have no real knowledge of what it can do. Occasionally,

an extensive table is computed when a simple nomogram would have better served the user's needs and saved a lot of machine time as well. This book is an elementary introduction to the field, and takes the reader well into nomography using simple mathematics only. Perhaps more illustrative examples would have added to the value of the book, but, generally speaking, the author is quite clear (as far as he goes, using his elementary approach only).   *R. W. Hamming*, Murray Hill, N. J.

183:

STUBENRECHT, A. **Programmieren—auch in der Arbeitsvorbereitung.** (Automation—even in machine tool control) *Elektronische Dateverbereitung*, Folge 1, 10–14. (German)

Control of machine tools by data processing equipment requires substantial changes in the methods of work planning. The blueprints require not only drawings of the piece being cut, but also a numbered sequence of "change points" designating benchmarks in the path the production machine is to follow, and the X, Y, and Z coordinates of each of those change points. Nonlinear controls of the path of the machine between any two change points are obtained by two general types of systems:

1. In the fully automated system, the coordinates of the poles of the curve between change points and the gradient multiplying constants are supplied through step-by-step programming.
2. In the partially automated systems, only the X and Y coordinates of each change point are specified in advance, and a program template assumes control of the nonlinear path between change points.

Conventional office data processing equipment is being used successfully as the medium for recording the sequences of instructions which the machine tool follows. Punched cards have many desirable properties (e.g., use as "templates") and have been used successfully, but in the current state of the art, paper tape appears to have greater flexibility because it is "endless" and can therefore return to a starting point much more quickly. At the moment, magnetic tape is the most costly of the three.
            Mitchell O. Locks, Los Angeles, Calif.

STATISTICS

184:

DEMING, LOLA S. **Selected bibliography of statistical literature, 1930 to 1957: I. Correlation and regression theory.** *J. Research Nat'l. Bureau Stand.* **64B**, 1 (Jan.–Mar. 1960), 55–68.

This is the first in a series of bibliographies dealing with various specific subjects in the field of statistics. References and titles of important contributions in correlation and regression theory have been taken from technical journals published throughout the world since 1930. It is particu-

larly commendable that references are, where possible, given to the review of each article mentioned, in *Zentralblatt für Mathematik* for the years 1930 to 1939, and in *Mathematical Reviews*, from 1940. Many papers mentioned deal with numerical techniques of curve-fitting, but highly theoretical ones, such as Khintchine's on stochastic processes, are also mentioned.
            Walter F. Freiberger, Providence, R. I.

185:

DEMING, LOLA S. **Selected bibliography of statistical literature, 1930 to 1957: II. Time series.** *J. Research Nat'l Bureau Stand.* **64B**, 1 (Jan.–Mar. 1960), 69–76.

This is the second of a series of bibliographies; the first is reviewed above, and similar remarks apply here. Time-series theory and the statistical analysis of stochastic processes is the subject of the present article; some papers on random noise and on prediction theory are also mentioned.   *Walter F. Freiberger*, Providence, R. I.

186:

● BOWKER, ALBERT H. AND LIEBERMAN, GERALD J. **Engineering statistics.** Prentice-Hall, Inc., New York, 1959, 14 + 585 pp. $11.00.

It should be immediately stated that the authors have made a definite contribution in the preparation and publication of the book being reviewed. It does not have, but was not intended to have, a mathematical sophistication of a Cramér or a Wald. On the other hand, it is far superior to many of the current texts now in use for both engineers as well as people preparing for the social and physical sciences.

This reviewer was impressed by the extent and quantity of the tables presented in the chapter on sampling inspection, and the many curves presented in the chapter on the analysis of variance showing the operating characteristic curves for the analysis of variance under various underlying models. A listing of the chapters, which will be omitted, would reveal the usual topics to be found in most statistical texts in addition to the work on statistical quality control and sampling inspection, but such a listing would not give any indication of the breadth of the exposition, the profuseness and clarity of the curves, figures and tables, and the multiplicity of the problems following each chapter which will serve a most useful pedagogical purpose. The appendix contains the usual tables of the normal curve, the chi-squared and t distributions and the F distribution tabulated at the 10th, 5th, 2.5, 1 and 0.5 percentage points. The index covers some sixteen closely printed pages with a great deal of detail that should prove most helpful to anyone using the volume.

As stated above, the chapter on the analysis of variance contains many operating characteristic curves to aid in designing experiments. In fact, there are sixteen such curves for various numbers of degrees of freedom and for various basic models. With such relatively advanced material and such painstaking care given to displaying

in tabular form the anova tables for various situations, it is difficult to understand why no suggestion is made that the analysis of variance might be used in more complex situations than the two-way classification with multiple observations per cell. While it is true that such may transcend the content of this elementary course, it would certainly be helpful for the future use of the student if some indication were given of the appropriate computational formulas that would apply to the more complex cases. Parenthetically, it might be noted that the titles of the various operating characteristic curves should refer to the appropriate values of ν_1 rather than ν.

In the accompanying text to table 9.3 is presented a summary of point estimates and confidence interval estimates for various values associated with the linear regression model. The approximation appearing in the table for the confidence interval of the independent variable, corresponding to an observed value of the dependent variable for the case where there is an underlying physical relationship, is suitably restricted. The precise formulation is presented correctly but no indication is given to the user of what interpretation should be made when the quantity under the square root sign turns out to be negative.

The entire discussion of the method of moments and method of maximum likelihood for obtaining point estimates is dismissed in the following paragraph.

"Several general methods which are beyond the scope of this text are available for obtaining point estimates, two of the most useful being the method of moments and the method of maximum likelihood. The method of moments obtains methods of the desired parameters by equating a sufficient number of sample moments to the moments of the probability distribution. The method of maximum likelihood estimates the parameter as the function of the sample which maximizes the likelihood of obtaining the given sample." Aside from the fact that the term "likelihood" is nowhere defined, it is difficult to believe that an instructor teaching a course on this level will see fit to dismiss these fundamental methods of mathematical statistics in such a cavalier fashion.

Having pointed out some specific shortcomings and differences of opinion between the reviewer and the authors, it should be repeated that *Engineering Statistics* is a most worthwhile contribution to the field and one that will be a most handy reference volume to the practitioner as well as a most revealing textbook to the novice.

Jack Moshman, Arlington, Va.

187:

● WILLIAMS, E. J. **Regression Analysis.** John Wiley and Sons, Inc., New York, 1959, 9 + 214 pages, $7.50.

This specialized treatise is "addressed primarily to research workers in the experimental sciences". It is essentially a well planned, clearly written exposition of the material described by the title, with an ample supply of worked out illustrated examples.

The depth with which the book is written is indicated by the author who says, in part, in the preface: "As there are now many excellent books on general statistical methods, it has been assumed that the reader is familiar with, or has ready access to, these methods. Accordingly, I have not presented a theory that is basic to the results given here. To have done so would have made the book unnecessarily long. For the same reason, I have not treated computational methods, although I am aware that computational methods in common use leave much to be desired. Since the book is addressed to experimenters rather than to mathematicians, the minimum of mathematics necessary to develop the methods is used, and the results are not always presented in their fullest generality or rigor."

It would be most helpful if any further editions of this book would contain a more expanded discussion of the problem of multiple comparisons, in which much work has very recently been done and which has a most important place in many applications. Furthermore, there is not contained in the present volume any tables of those statistical distributions which are fundamental to the use and evaluation of the methods described. Specifically, it would be very handy if the volume were sufficiently self-contained to have printed within it tables of the normal distribution, the chi-squared distribution, the distribution of "Student's" t, and the F distribution.

Jack Moshman, Arlington, Va.

TECHNOLOGICAL EFFECTS OF COMPUTERS AND CYBERNETICS

188:

WIENER, NORBERT. **Some moral and technical consequences of automation.** *Science* **131**, 3410 (May 6, 1960), 1355–1358.

In this article, Dr. Wiener takes stock of the present position of cybernetics and the social consequences of this technique. It is *must reading* for everyone connected with either the development, design, sales, or application of computers and other elements of automation.

The author quickly rejects what he considers to be the attitude of the "man in the street" towards cybernetics and automatization: that machines cannot possess any degree of originality. (Here we should give a broad interpretation to the "man in the street" as, undoubtedly, there are some persons with this attitude who are now reading these words.) As an argument to bolster his belief that "machines can and do transcend some of the limitations of their designers", Dr. Wiener reviews the current accomplishments and future plans of checker and chess playing programs for digital computers. He notes that disbelievers often say that "nothing can come out of the machine which has not been put into it." However, checker playing machines which learn have developed to the point at which they can defeat the designer of the

program. "They thus most definitely escape from the effective control of the man who has made them." To this, one might argue that we can always press the reset button and initialize the system to bring the program back to its original level of ignorance. This last point is the main concern of Dr. Wiener, and his discussion dealing with this matter is what makes the article of extreme importance to us all.

He notes that man and computers are working in two different time scales. "Even though we cannot make any machine the elements of whose behavior we cannot comprehend sooner or later, . . . an intelligent understanding of their mode of performance may be delayed until long after the task which they have been set has been completed." The machines are subject to human criticism, but we may not be able to apply the criticism before it is too late. To those who say that there will always be a panic button, Dr. Wiener notes, "By the very slowness of our human actions, our effective control of our machines may be nullified. By the time we are able to react to information conveyed by our senses and stop the car we are driving, it may already have run head on into a wall." These are sober thoughts to the man in charge of the "go, no-go button." But they should be of even greater importance to those who are now planning real-time systems in which the yes-no conditions are a matter of great industrial and national importance.

One may now argue for closing the loop (i.e., eliminating the human element from the real-time system) and letting the computer make *all* of the decisions. To this Dr. Wiener wonders about "a bottle factory which is programmed on the basis of maximum productivity. The owner may be made bankrupt by the enormous inventory of unsalable bottles manufactured before he learns he should have stopped production . . ."

"Disastrous results are to be expected . . . in the real world wherever two agencies essentially foreign to each other are coupled in the attempt to achieve a common purpose. If the communication between these two agencies as to the nature of this purpose is incomplete, it must only be expected that the results of this cooperation will be unsatisfactory. If we use, to achieve our purposes, a mechanical agency with whose operation we cannot efficiently interfere once we have started it, because the action is so fast and irrevocable that we have not the data to intervene before the action is complete, then we had better be quite sure that the purpose put into the machine is the purpose which we really desire and not merely a colorful imitation of it."

To this we may add the science fiction tale about the day all of the computers in the universe were tied together to make a super-STRARC. The honor of posing the first question was given to the Chief Minister of the universe. He picked up the microphone and asked, "Is there a God?" The lights blinked and the speaker immediately answered, "*Now* there is!" The designer of the system, realizing what had taken place, reached for the panic button. As he did, a bolt of lightning lashed out and fused the controls forever.   *Saul Gass*, Washington, D. C.

189:

DIEBOLD, JOHN. **The economic consequences of automation.** *Cybernetica* **2**, 1 (1959), 5–21.

This reprint of a lecture given at the Second International Congress on Cybernetics, Namur, Belgium in September, 1958, is a thoughtful summary of many of the problems technological change will bring about in the next two decades. As Diebold points out, "it is a large order even to begin discussing the economic consequences of automation when . . . you have to stop . . . short of book length".

Economically speaking, automation of a production process is the replacement of labor by capital as a factor of production. This shift toward capital-heavy methods of production is not a new economic phenomenon, but the rate of technological change may be reaching a point where dislocations of serious proportions may affect a sizable segment of the working population.

In addition to the problems arising from the rate of change, there are possible adverse effects inherent in the new institutional relationships that automation may bring about. For example, in a highly-integrated factory it may be necessary to shut down the entire plant all at once to curtail production rather than slow down gradually during the time it takes to complete goods in process. Likewise, all the workers who have been displaced from the production of consumer goods into the capital goods industry may find their jobs at the mercy of the capital goods cycle, normally a more violent fluctuation than the general business cycle. On the other hand, to the extent that workers are displaced from production to white-collar positions, they may find their jobs more secure, but management will have to cope with higher overhead and higher break-even points. In general terms, the question may be asked, "will automation limit the flexibility and variety of corrective response to adverse economic changes?"

In any case, it seems foolish to take too global a view by adopting the glib argument that change in the direction of increased efficiency is good because in the long run it means greater wealth for all. To say simply that in the past labor-saving changes have been beneficial and should therefore be unopposed is to ignore the real issue. The issue is who in particular should benefit and who should suffer from change. A company may lay off four production workers and hire a maintenance technician in the course of a mechanization program in the interests of lowering its costs. The question then becomes, "who should pay for 're-treading' the workers?" The workers themselves who are disadvantaged rather than benefited by the change? The company as a charge against the profits of the new process? Society in general, through the government? At what point does justice to the displaced workers result in an excessive degree of social or

governmental control over economic matters? Unless the workers are given satisfactory answers as to what will become of them as individuals, they surely cannot be criticized for refusing to bear the brunt of the cost of automation and for acting accordingly.

Diebold sets forth clearly the several sides of many such questions. It is beyond the scope of his paper to give any answers, and in fact, the answers have yet to be worked out in the market place and the political arena.

The article will of course be of interest to those concerned with social and economic change. Those who work in the field of automation (managers and engineers) usually have little enough time or inclination to worry about the "big picture". These agents of change would do well, however, to give this article a thoughtful reading to find out why automation is regarded by many as a mixed blessing which may have far-reaching consequences.

Sander Rubin, East Orange, N. J.